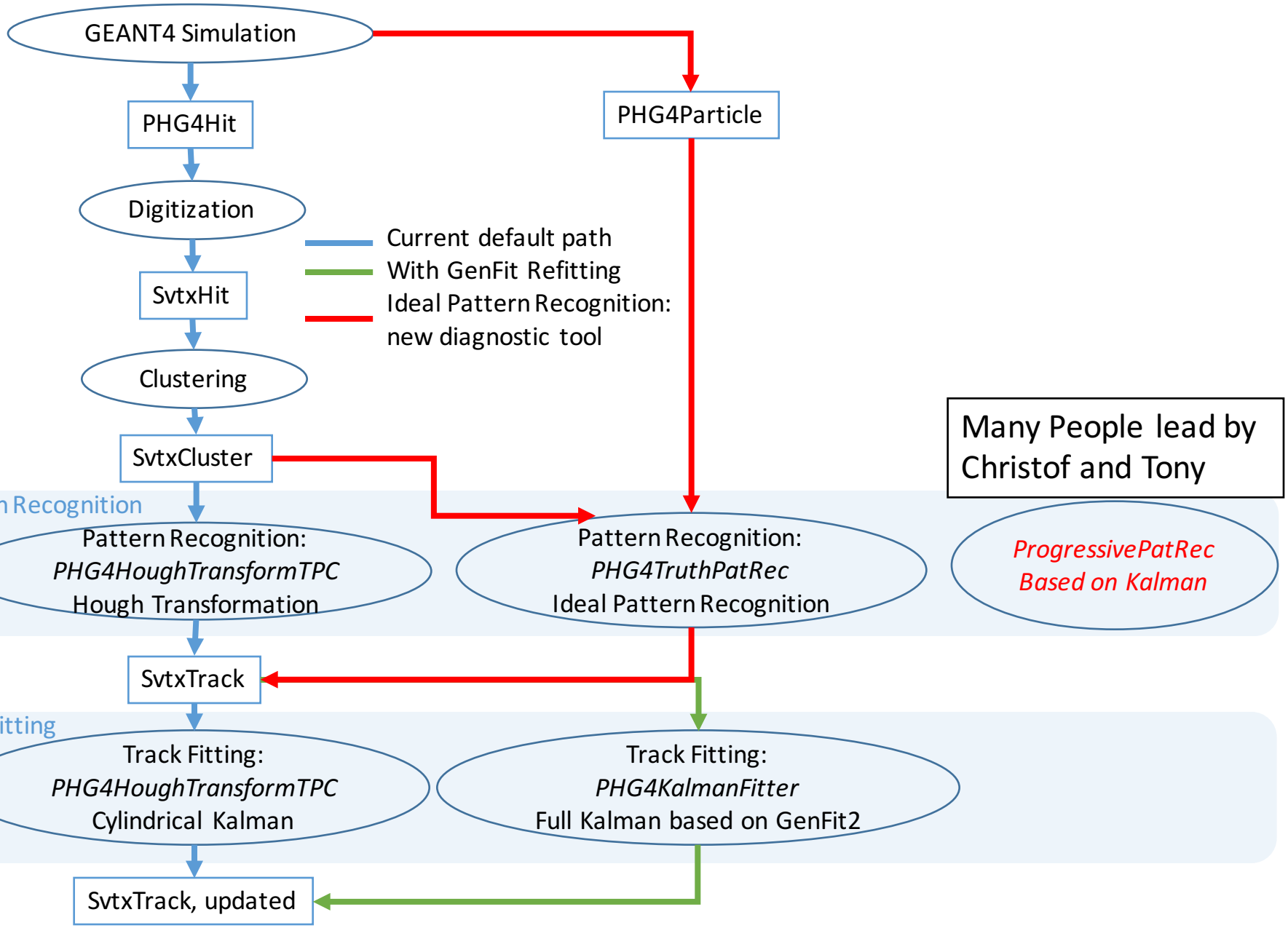
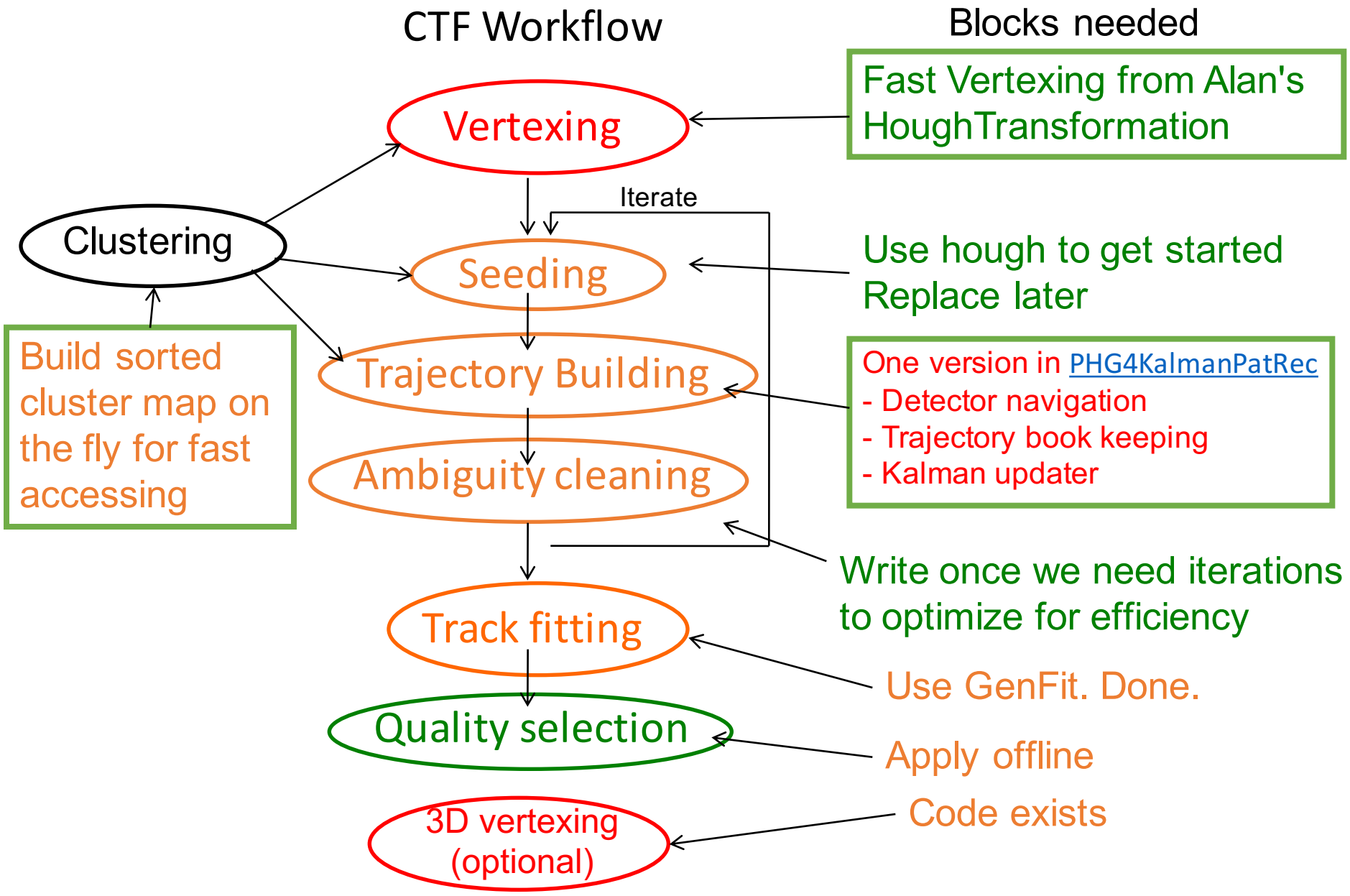
Updates on PHG4KalmanPatRec

Christof Roland(MIT), Anthony Frawley(FSU),
Jin Huang(BNL), Haiwang Yu (NMSU)

sPHENIX tracking

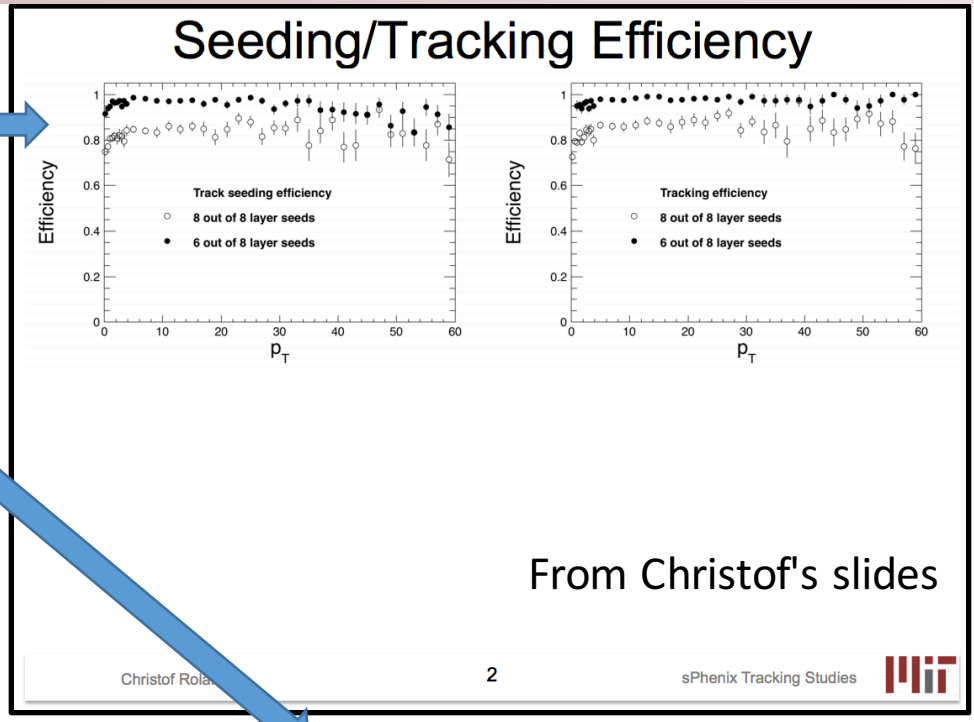


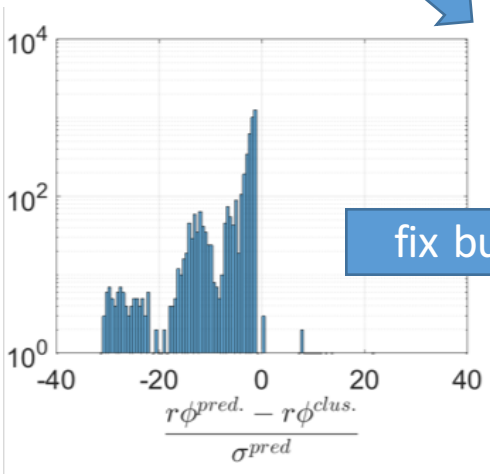
Christof's proposal



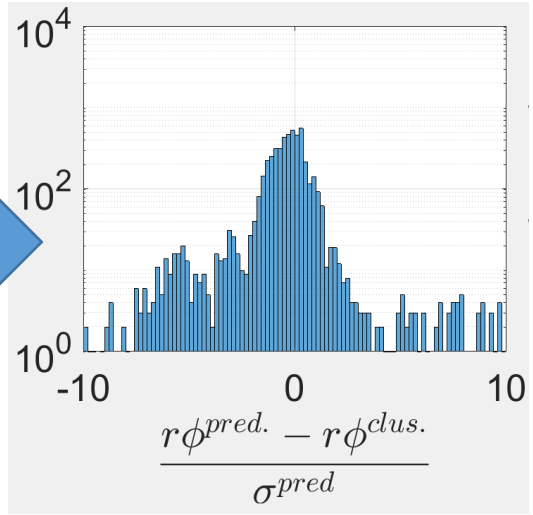
Recent progress

- Seeding: Christo, Sourav, Haiwang
  - Low eff. with 8/8, high ghost with 6/8.
  - Seeds merging:
    - Parameter matching and hit pattern - Haiwang
    - Hit pattern - Christof
- Track propagation - Haiwang
  - bug fixing: didn't register fitting info for each TrackPoint - Wrong and Slow, much better eff. and speed after fixing.
  - Track splitting handling
  - Propagating termination after missing many layers
  - Save track in SvtxTrack form instead of PHGenFit::TRack
- Dedicate full fitting to PHG4TrackKalmanFitter
  - Memory hog - Haiwang
- Reducing memory usage - Chris





fix bug



Module is in working progress

module:
https://github.com/HaiwangYu/coresoftware/blob/KalmanPatRec/simulation/g4simulation/g4hough/PHG4KalmanPatRec.h

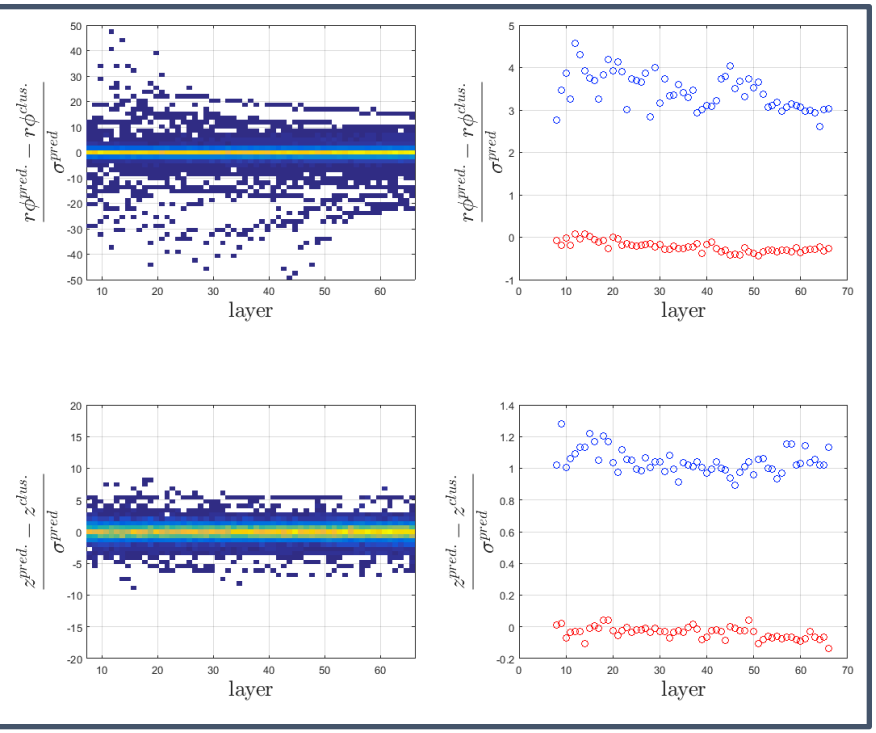
example macro:
https://github.com/HaiwangYu/macros/blob/KalmanPatRec/macros/g4simulations/RunKalmanPatRec.C

working progress

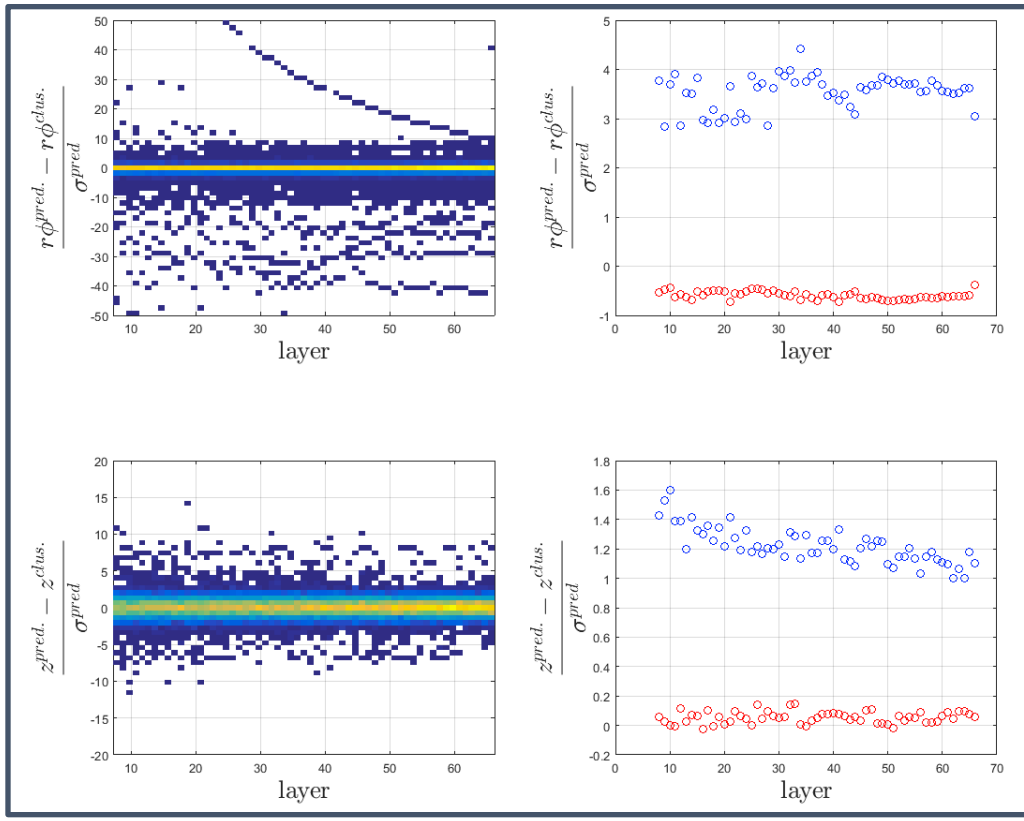
Search Win vs. Layer

- ana.49
- Single pion simulation
- pull vs. layer
- mean, sigma of pull vs. layer

2GeV

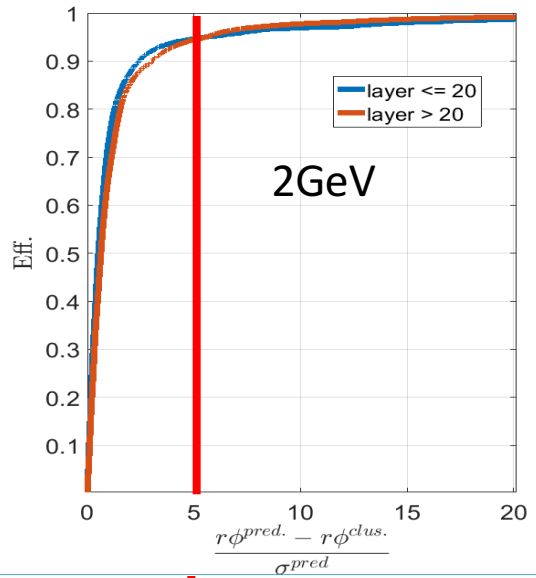


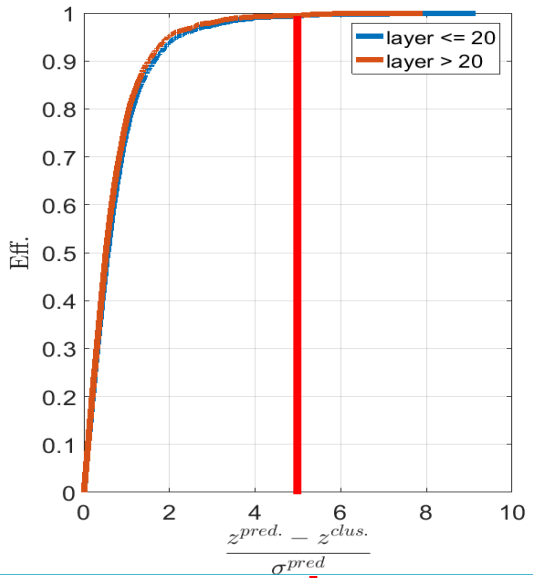
30GeV

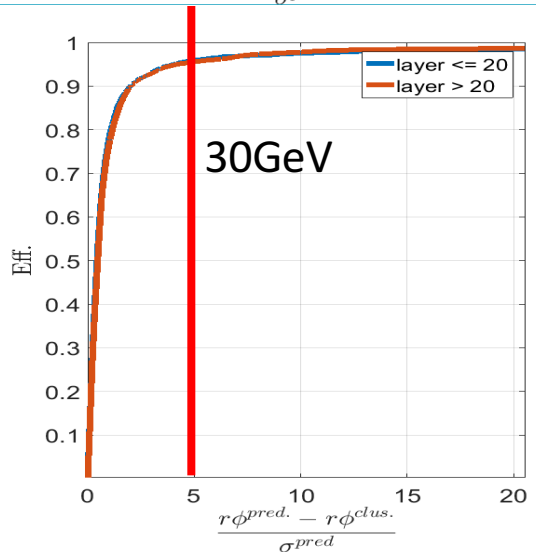


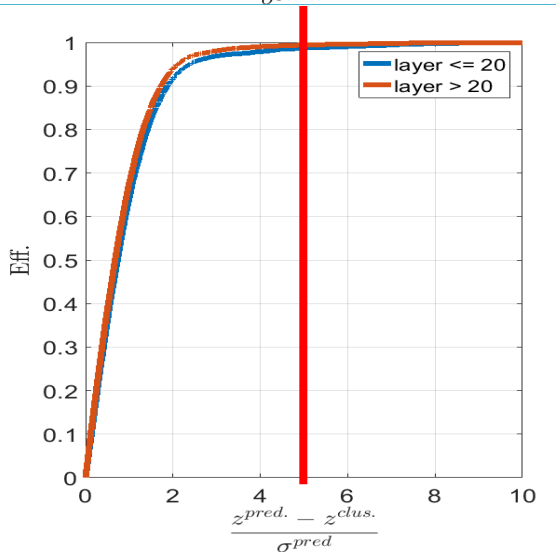
Cluster Pulls - Search Win.

- ana.49
- Single pion simulation
- CDF of |pull| for each found cluster



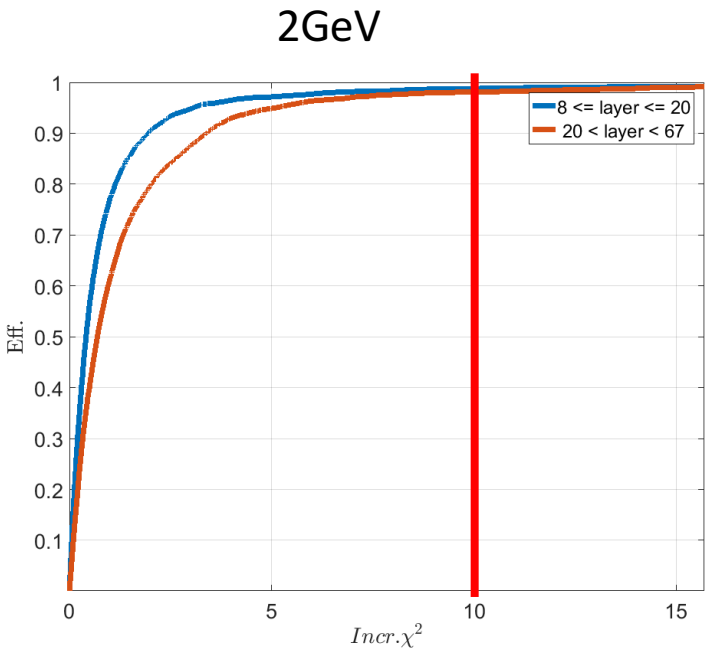


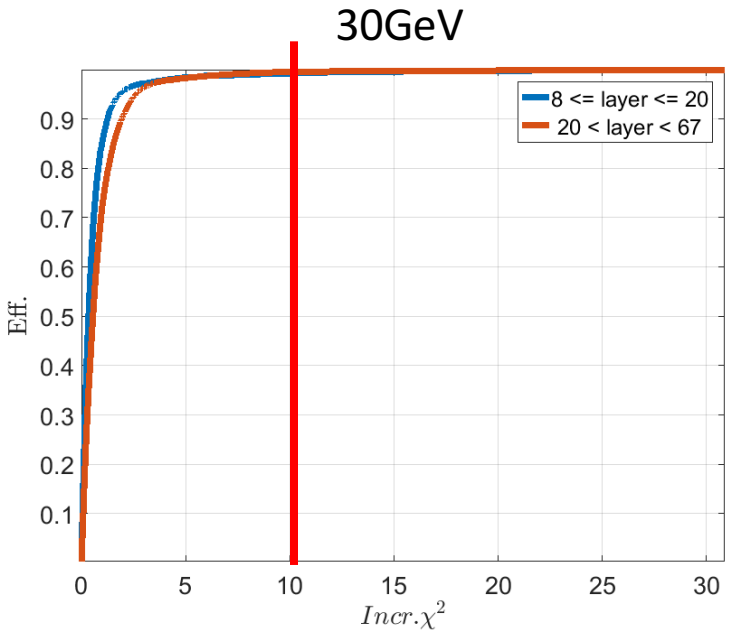




χ^2 for each found cluster

- ana.49
- Single pion simulation
- CDF of χ^2 for each found cluster





Initial Hijing test - 0.5 - 30 GeV

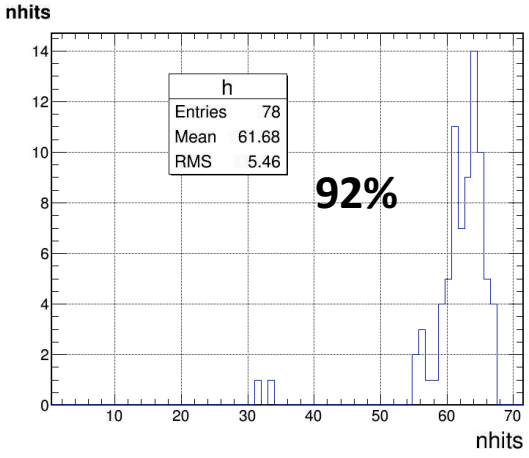
- Cylindrical MAPT+IT+TPC
- 100 pions (0.5 - 30) embedded in central Hijing events.

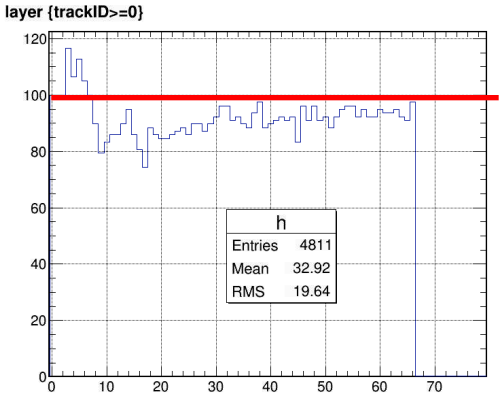
- 8/8 seeding (low eff.)
- search win. 5σ
- $\chi^2 < 5$ for each cluster association and splitting

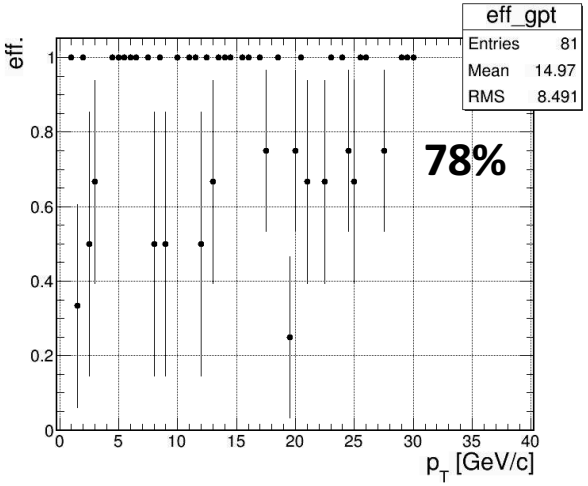
- Track termination handling is thrown away in this test

Processed 1000 seeds + 40k splitting

```
=============== Timers: ===============
Seeding time:                  22.3372 sec
   - Seeds Cleanup:            0.0470587 sec
Pattern recognition time:      182.518 sec
   - Track Translation time:   13.6332 sec
   - Cluster searching time:   56.807 sec
     - Encoding time:          6.30357 sec
     - Map iteration:          32.2665 sec
   - Kalman updater time:      52.8471 sec
Full fitting time:             0 sec
Output IO time:                0 sec
=======================================
```







Initial Hijing test - 2GeV

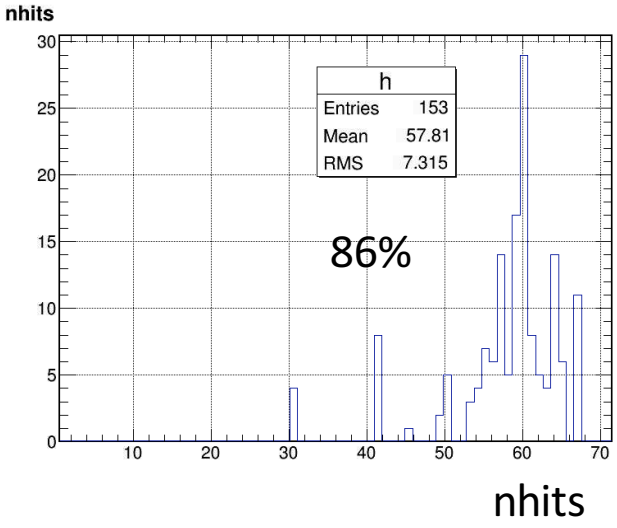
- Cylindrical MAPT+IT+TPC
- 100 2GeV pions embedded in central Hijing events.

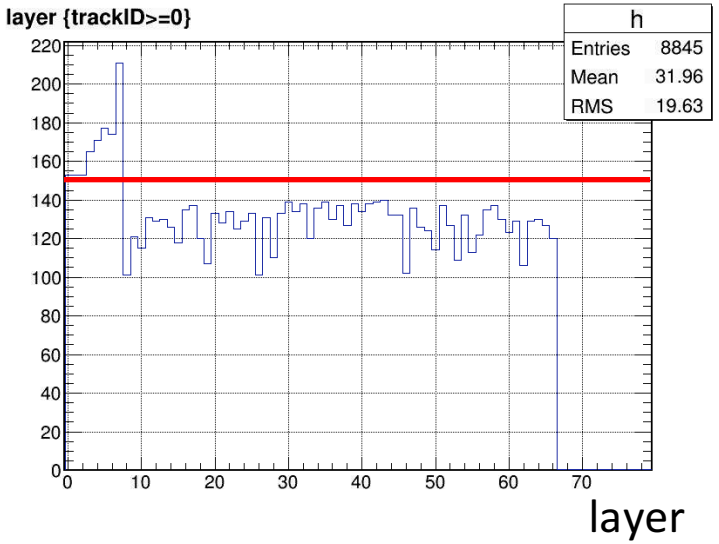
- 8/8 seeding (low eff.)
- search win. 5σ
- χ^2 < 5 for each cluster association and splitting

- Keep Track terminated with 30+ hits

Processed 1000 seeds + 30k splitting

```
============== Timers: ===============
Seeding time:                  25.7773 sec
   - Seeds Cleanup:            0.0479921 sec
Pattern recognition time:      225.897 sec
   - Track Translation time:   14.7718 sec
   - Cluster searching time:   133.77 sec
     - Encoding time:          5.54818 sec
     - Map iteration:          117.857 sec
   - Kalman updater time:      45.4001 sec
Full fitting time:             0 sec
Output IO time:                0 sec
======================================
```





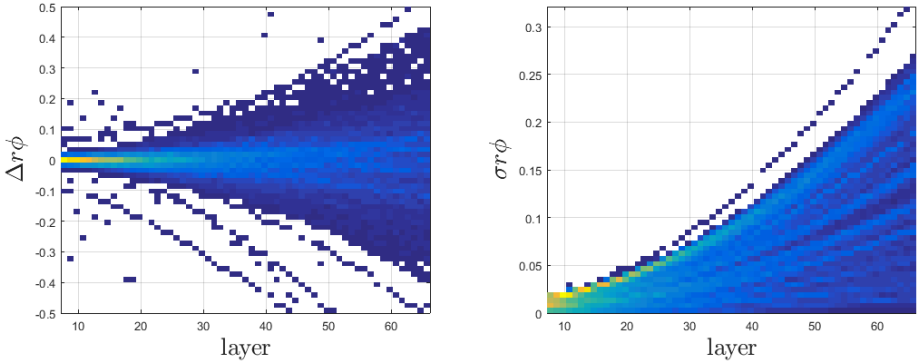
Next

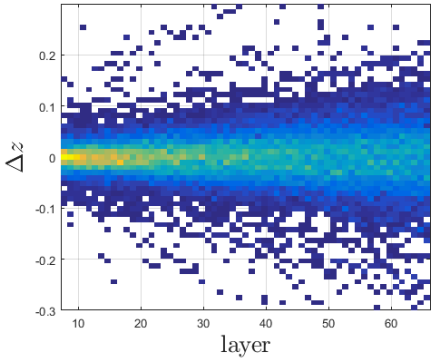
- TPC - Carlos, Veronica
- Better seed merging - Christof
- Seeding and full tracking testing - Sourav
- Look more closely at track propagation in Hijing - Haiwang
  - Search Win, chi2, true splitting or random comb. etc.
- Reduce full fitting memory usage - Haiwang
- Ambiguity cleaning - Sanghoon
- Multiple vertexing - Sanghoon
- Reduce IO memory usage - Chris

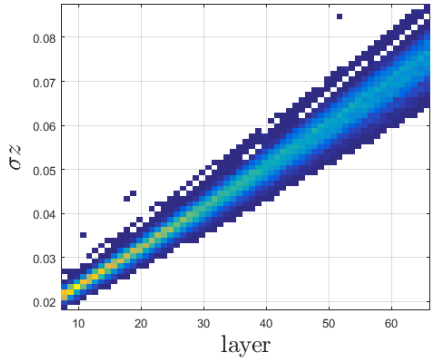
Backups

ana.49

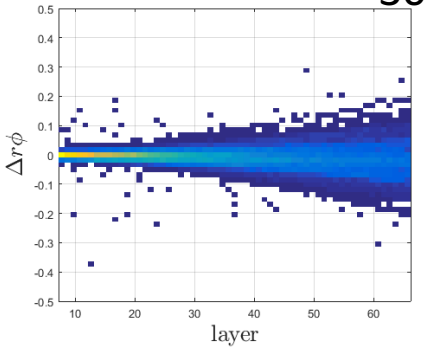
2GeV

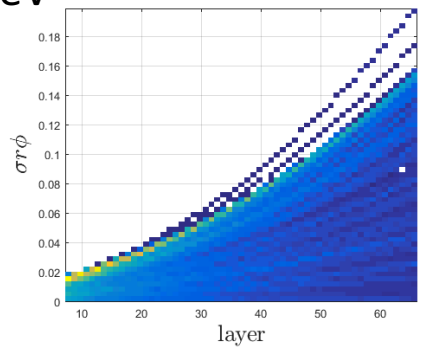


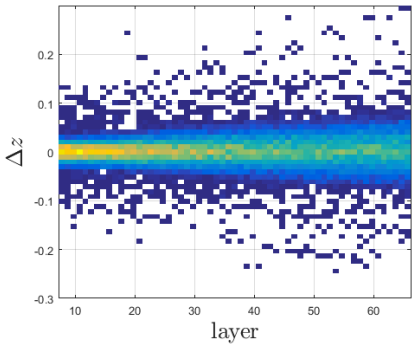


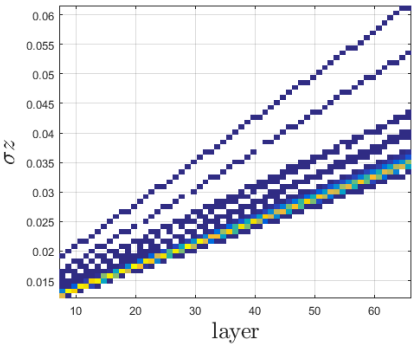


30GeV







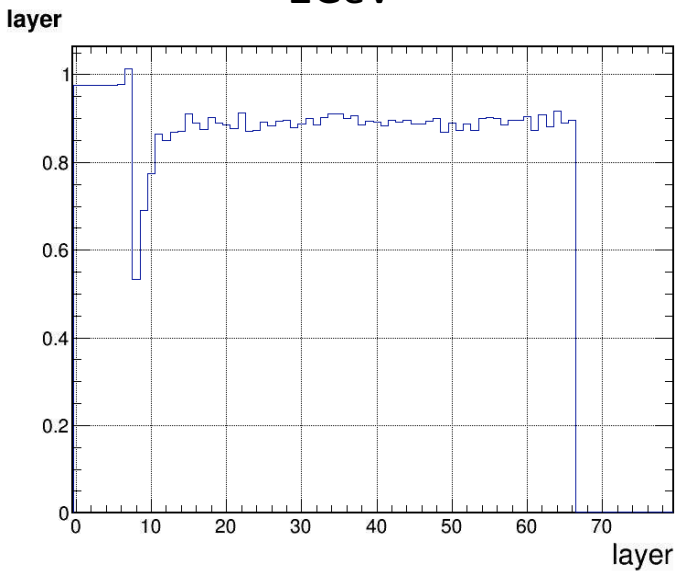


ana.49

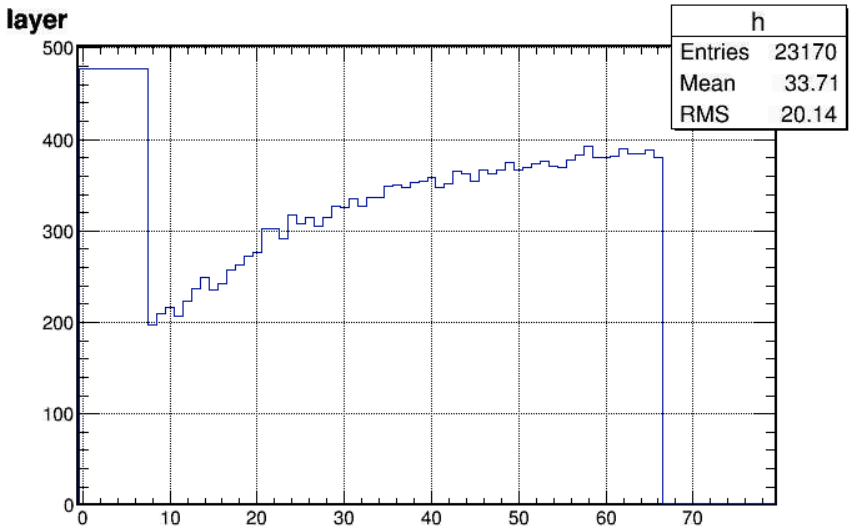
```
Fun4AllServer::setRun(): could not get timestamp for run  0, using tics(0) timestamp: Wed Dec 31 19:00:00 1969
PHG4Reco::InitRun - export geometry to DST via tmp file /tmp/PHGeomUtility_geom_file_2841.gdml
G4GDML: Writing '/tmp/PHGeomUtility_geom_file_2841.gdml'...
G4GDML: Writing definitions...
G4GDML: Writing materials...
G4GDML: Writing solids...
G4GDML: Writing structure...
G4GDML: Writing setup...
G4GDML: Writing surfaces...
G4GDML: Writing '/tmp/PHGeomUtility_geom_file_2841.gdml' done !
----------------------------------------

List of Nodes in Fun4AllServer:
Node Tree under TopNode TOP
TOP (PHCompositeNode)/
   DST (PHCompositeNode)/
      PHG4INEVENT (PHDataNode)
      PHHepMCGenEvent (IO,PHHepMCGenEvent)
      G4HIT_PIPE (IO,PHG4HitContainer)
      G4HIT_SVTX (IO,PHG4HitContainer)
      G4HIT_BH_1 (IO,PHG4HitContainer)
      G4TruthInfo (IO,PHG4TruthInfoContainer)
      G4CELL_SVTX (IO,PHG4CellContainer)
      SVTX (PHCompositeNode)/
         SvtxHitMap (IO,SvtxHitMap_v1)
         SvtxClusterMap (IO,SvtxClusterMap_v1)
   RUN (PHCompositeNode)/
      PIPE (PHCompositeNode)/
         G4GEOPARAM_PIPE (IO,PdbParameterMapContainer)
      CYLINDERGEOM_PIPE (IO,PHG4CylinderGeomContainer)
      SVTX (PHCompositeNode)/
         G4GEOPARAM_SVTX (IO,PdbParameterMapContainer)
      CYLINDERGEOM_SVTX (IO,PHG4CylinderGeomContainer)
      SVTXSUPPORT (PHCompositeNode)/
         G4GEOPARAM_SVTXSUPPORT (IO,PdbParameterMapContainer)
      G4GEOPARAM_BH_1 (IO,PdbParameterMapContainer)
      CYLINDERGEOM_BH_1 (IO,PHG4CylinderGeomContainer)
      GEOMETRY (PHDataNode)
      GEOMETRY_IO (IO,PHGeomIOTGeo)
      CYLINDERCELLGEOM_SVTX (IO,PHG4CylinderCellGeomContainer)
   PAR (PHCompositeNode)/
      PIPE (PHCompositeNode)/
         G4GEO_PIPE (PHDataNode)
      SVTX (PHCompositeNode)/
         G4GEO_SVTX (PHDataNode)
      SVTXSUPPORT (PHCompositeNode)/
         G4GEO_SVTXSUPPORT (PHDataNode)
      G4GEO_BH_1 (PHDataNode)


Error in <TBufferFile::WriteByteCount>: bytecount too large (more than 1073741822)
All done
433.710u 17.076s 7:40.75 97.8%  0+0k 2040+352io 1pf+0w
```

Nightly Build, Tr14

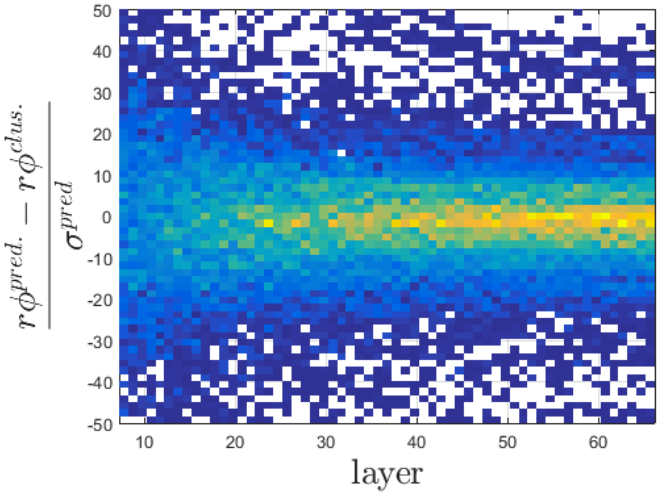
2GeV

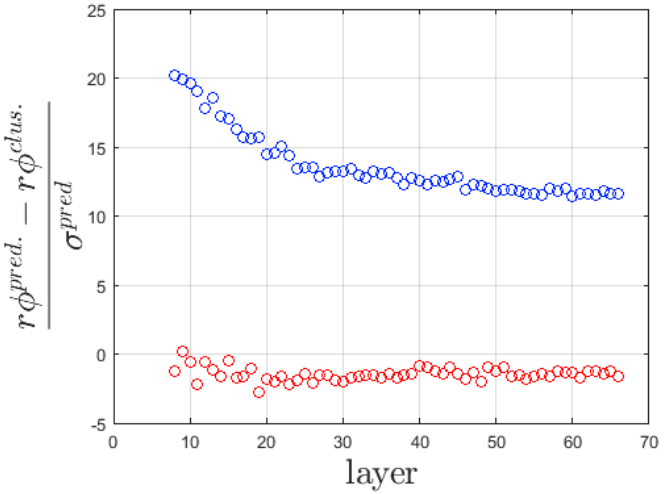


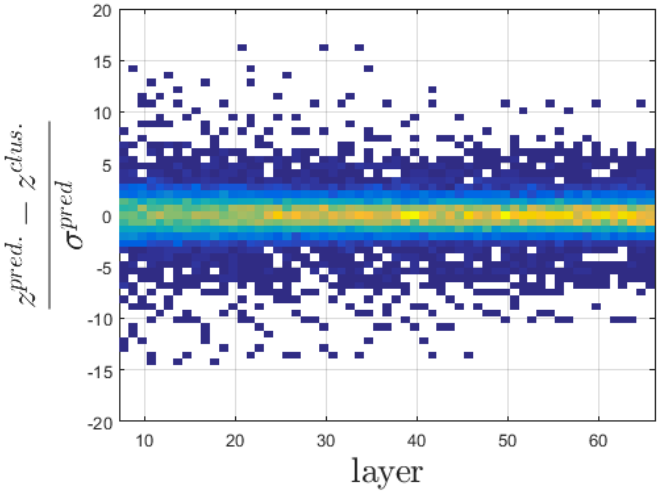
30GeV

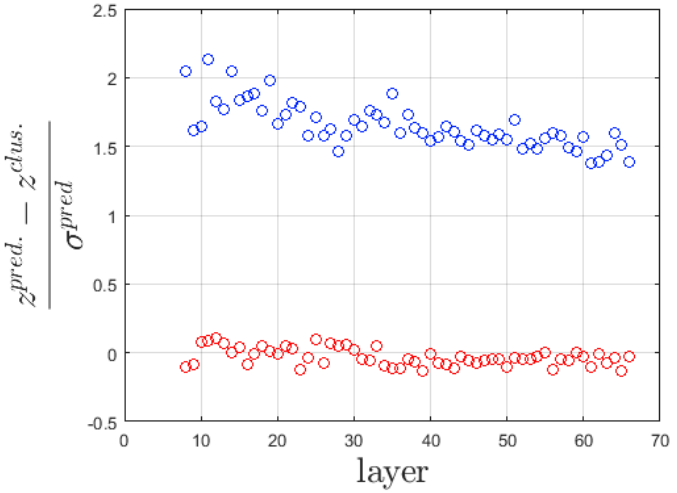


Nightly Build, Tr14, 30GeV

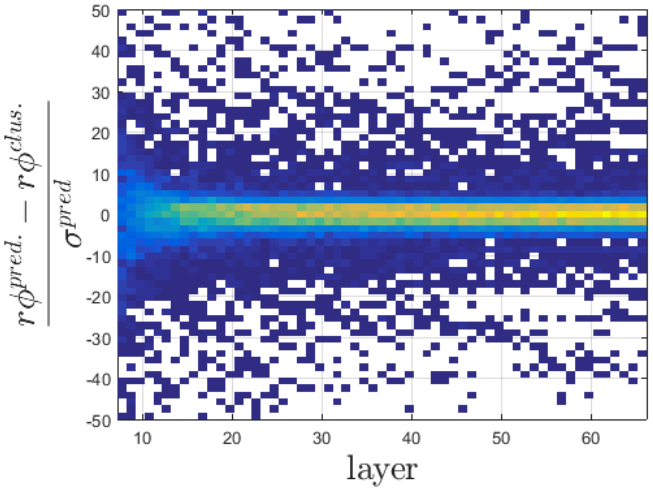


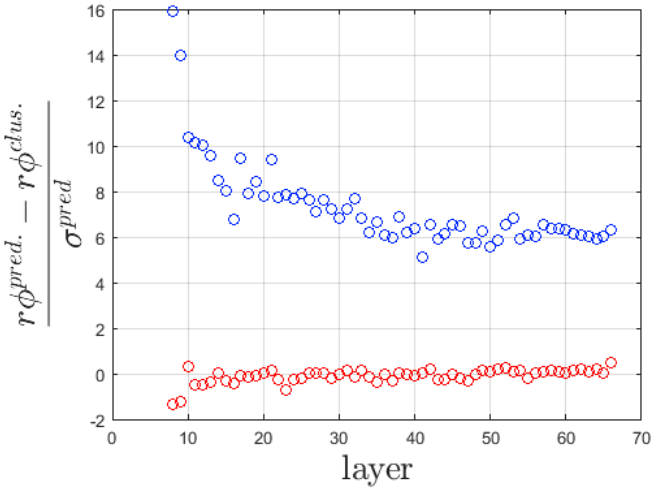


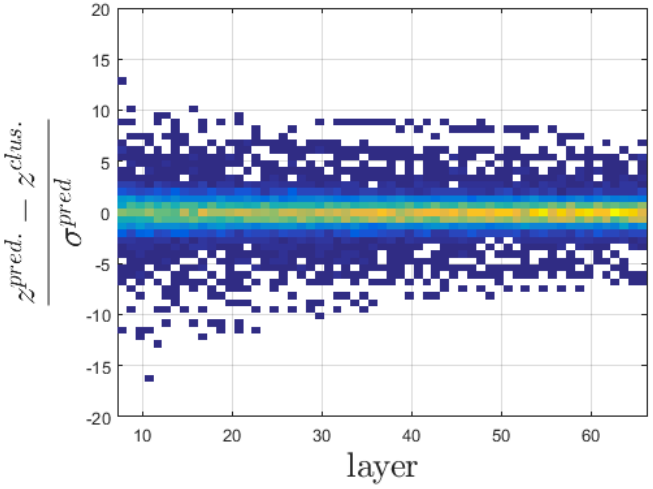


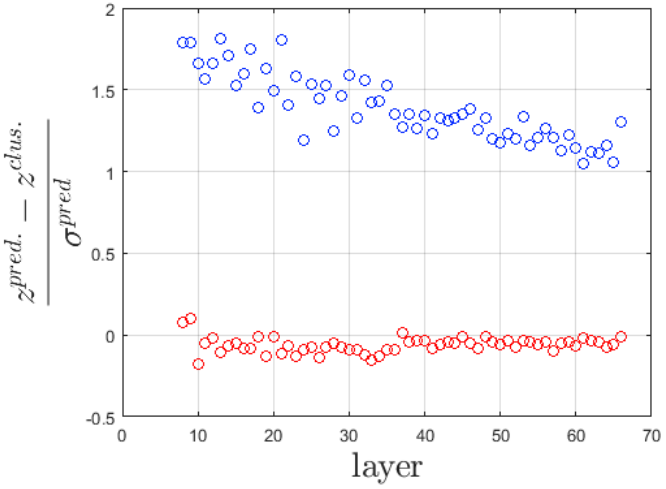


Nightly Build, Tr14, 2GeV

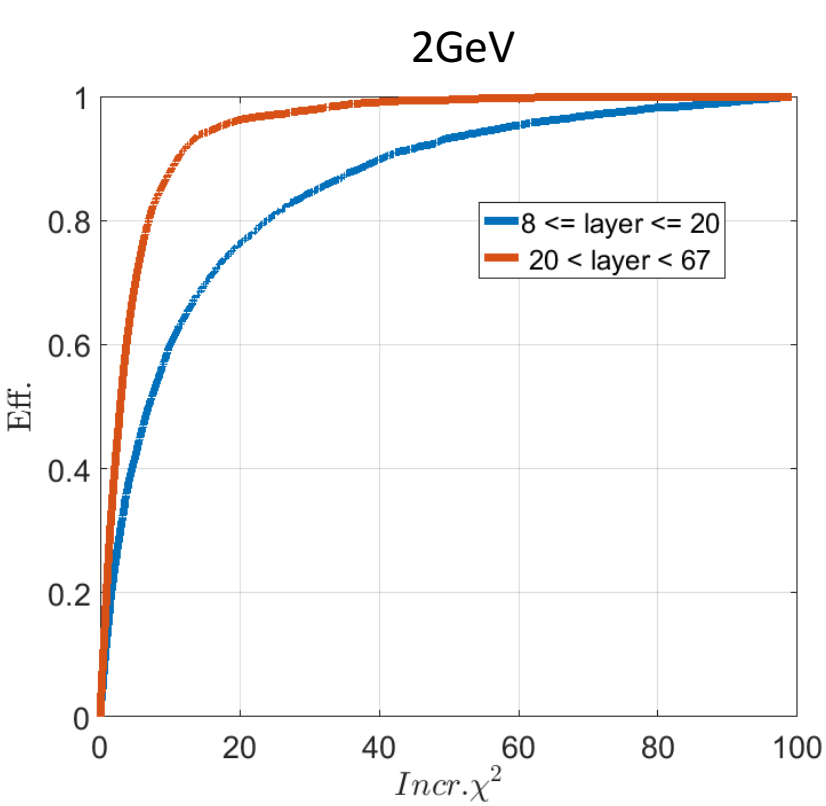


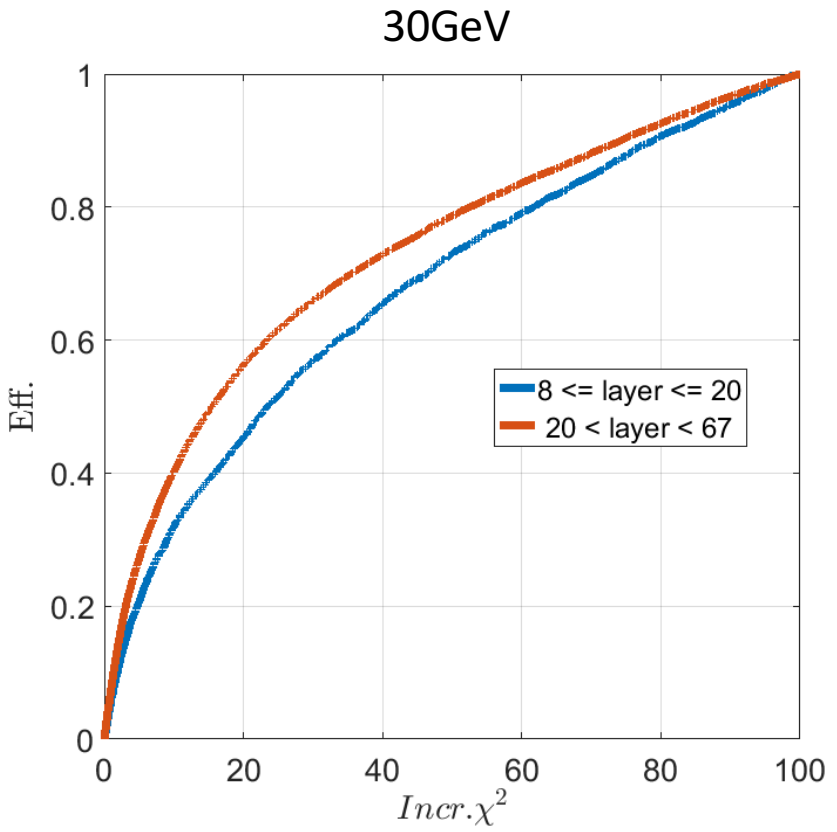




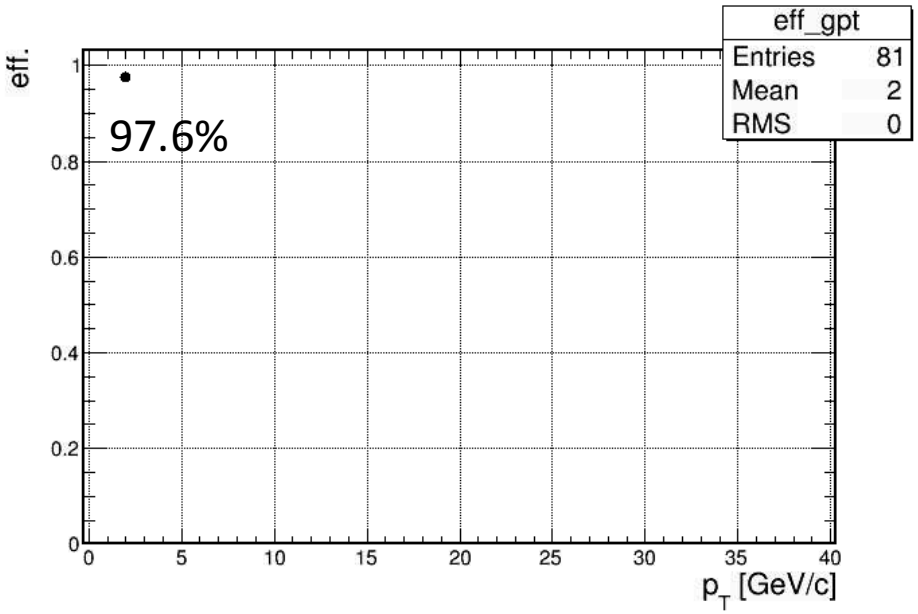


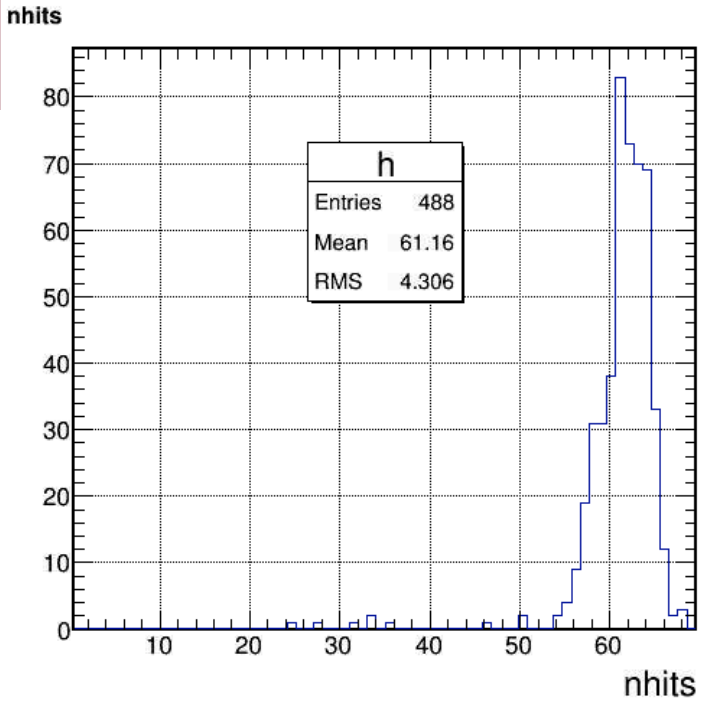
Nightly Build, Tr14



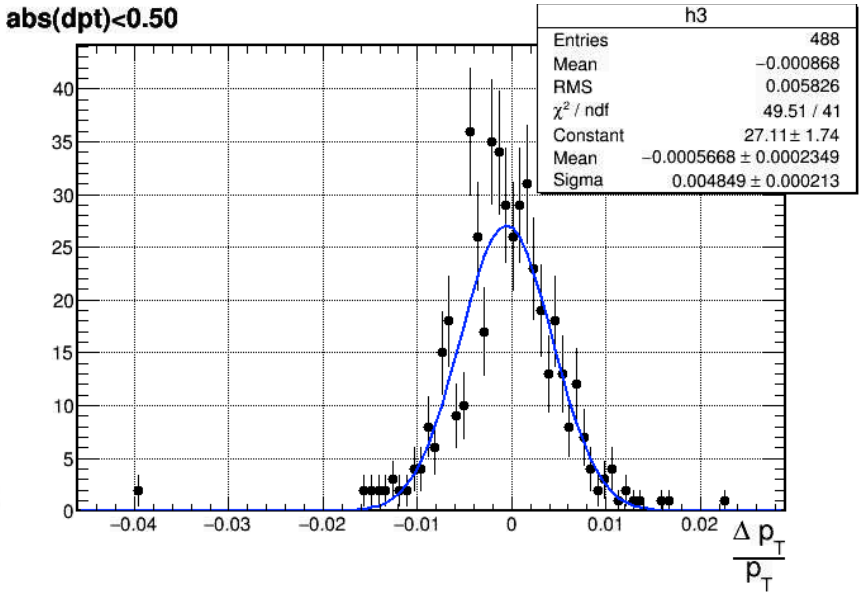


Nightly Build, Tr14






```
man_pat_rec->set_search_win_rphi(100.);
man_pat_rec->set_search_win_z(5.);

man_pat_rec->set_max_incr_chi2(100.);
man_pat_rec->set_max_consecutive_missing_layer(60);
```



```
1884:    itrack: 18: {49, 149, 248, 361, 463, 564, 666, 790, }
1931: rel track: 19: {49, 149, 248, 361, 463, 565, 666, 790, }

*************************************************************************
*    Row    *  gtrackID *     hitID *         r *      rphi *         z *
*************************************************************************
*      564 *        90 *       564 * 10.006000 * -3.309976 * -4.651305 *
*      565 *        33 *       565 * 10.005999 * -3.293967 * -4.651305 *
*************************************************************************
```

```
1884:    itrack: 24: {58, 158, 260, 371, 473, 575, 678, 789, }
1931: rel track: 94: {58, 158, 260, 371, 473, 576, 678, 789, }
1931: rel track: 95: {58, 158, 260, 371, 474, 575, 678, 789, }
1931: rel track: 96: {58, 158, 260, 371, 474, 576, 678, 789, }

*************************************************************************
*    Row    *  gtrackID *     hitID *         r *      rphi *         z *
*************************************************************************
*      473 *        16 *       473 * 8.0059999 * 1.5729751 * -4.161580 *
*      474 *        43 *       474 * 8.0060000 * 1.5889849 * -0.594511 *
*      575 *        16 *       575 * 10.006000 * 1.9571689 * -4.651305 *
*      576 *        43 *       576 * 10.006000 * 1.9571689 * -1.162826 *
*************************************************************************
```

```
1884:    itrack: 70: {7, 106, 205, 308, 419, 521, 624, 751, }
1931: rel track: 69: {7, 106, 205, 308, 419, 521, 623, 751, }
*****************************************************************************
*    Row   *  gtrackID *     hitID *         r *      rphi *          z *
*****************************************************************************
*      623 *        58 *       623 * 12.005999 * -34.28832 * -1.188429 *
*      624 *        14 *       624 * 12.006000 * -34.27232 * -3.565288 *
*****************************************************************************
```

```
1884:    itrack: 43: {78, 178, 280, 391, 493, 595, 696, 759, }
1931: rel track: 44: {78, 178, 280, 391, 493, 595, 697, 759, }
*****************************************************************************
*    Row   *  gtrackID *     hitID *         r *      rphi *          z *
*****************************************************************************
*      696 *        45 *       696 * 12.006000 * 17.864507 *          0 *
*      697 *       100 *       697 * 12.006000 * 17.864507 * 3.5652883 *
*****************************************************************************
```